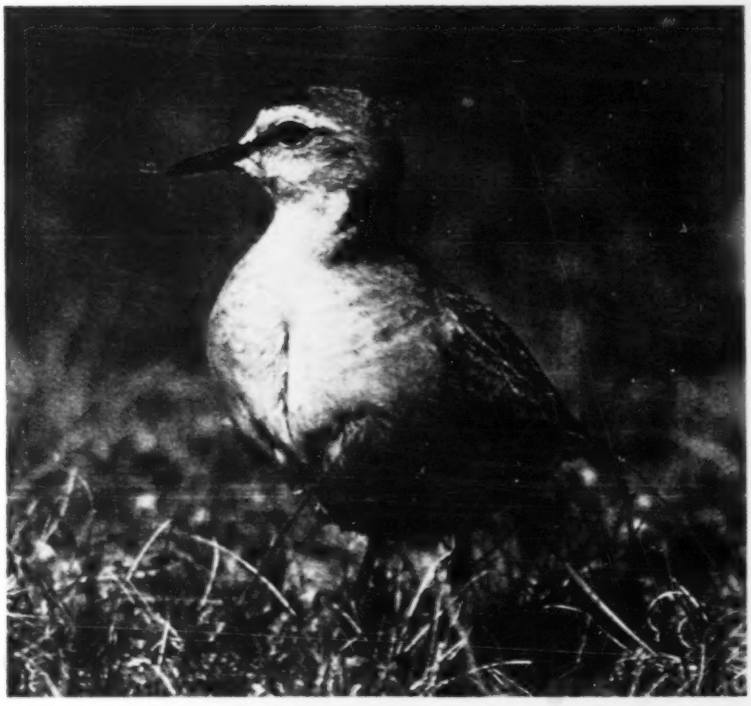
Fish & Wildlife Division

RESOURCE STATUS AND ASSESSMENT BRANCH

Mountain Plover Habitat and Population Surveys in Alberta, 2001



Alberta Species at Risk Report No. 37

Alberta
SUSTAINABLE RESOURCE DEVELOPMENT

Mountain Plover Habitat and Population Surveys in Alberta, 2001

Cleve Wershler and Cliff Wallis

Alberta Species at Risk Report No. 37

February 2002

Alberta
SUSTAINABLE RESOURCE DEVELOPMENT

Publication No. I/054
ISBN: 0-7785-2004-8 (Printed Edition)
ISBN: 0-7785-2005-6 (On-line Edition)
ISSN: 1496-7219 (Printed Edition)
ISSN: 1496-7146 (On-line Edition)

Photograph by: Cleve Wershler

For copies of this report, contact:

Information Centre- Publications
Alberta Environment/ Alberta Sustainable Resource Development
Main Floor, Great West Life Building
9920- 108 Street
Edmonton, Alberta, Canada T5K 2M4
Telephone: (780) 422-2079

OR

Information Service
Alberta Environment/ Alberta Sustainable Resource Development
#100, 3115- 12 Street NE
Calgary, Alberta, Canada T2E 7J2
Telephone: (403) 297- 3362

OR

Visit our web site at:
http://www3.gov.ab.ca/srd/fw/riskspecies/

This publication can be cited as:

Werschler, C. and C. Wallis. 2002. Mountain plover habitat and population surveys in Alberta, 2001. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species at Risk Report No. 37. Edmonton, AB.

EXECUTIVE SUMMARY

Sweetgrass Consultants was contracted in 2001 by Alberta Fish and Wildlife Division to undertake Mountain Plover habitat and population surveys on the Onefour Sub-station and adjacent crown lands. This work complemented Mountain Plover surveys being conducted in 2001 in other parts of southeastern Alberta and southwestern Saskatchewan.

The project involved (1) an aerial survey to identify potential habitats for ground-truthing, (2) reconnaissance and detailed-level ground surveys, and (3) assessments of habitat potential and suitability.

Candidate sites of potential habitat were identified in the aerial survey using indicators developed in previous Mountain Plover surveys, and using aerial comparisons with known breeding habitats. Major habitat indicators included extensive native grassland, shrub-free areas, intensively grazed range, recent burns, level topography, and better-drained soils.

In the ground surveys, major indicators of habitat potential and suitability included short vegetation, level terrain, and a significant bare ground component. A total of 19 sites were assessed as having potential nesting habitat, including 17 with high potential and 2 with limited potential. Habitats with limited potential include sites with more undulating topography, poorly drained soils, shrubby vegetation, or limited size.

73% of sites with high potential in Canada are located in southeastern Alberta—the Lost River-Milk River and Wildhorse regions—and adjacent lands in the southwestern corner of Saskatchewan. The most extensive high potential habitat is in the Lost River-Milk River region of Alberta where most breeding records and the largest populations of Mountain Plovers in Canada have been documented.

Of the 17 sites with high potential, 8 had high suitability. Compared with previous years, there appeared to be a greater component of intensively grazed habitat. However, this was at least partly related to continuing severe-extreme drought conditions that magnified the effects of grazing on plant vigor and litter resources. Research has indicated that drought can make habitats less productive, resulting in poor breeding success and early departure of adults from the breeding grounds. It is possible that habitat conditions were actually less suitable than they were assessed to be during the field surveys.

No Mountain Plovers were observed in the formal survey, but there were three reports of adults (two singles and one pair) early in the breeding season by local residents familiar with the species.

Restricted areas of suitable habitat is the major factor limiting habitat suitability. In addition to the requirement of intensive grazing, season of grazing also appears to be important. The majority of breeding sites in Alberta have been winter or spring-grazed. Removal of the previous season's plant litter by the beginning of the breeding season is a

prerequisite for suitable breeding habitat.

It has been hypothesized that breeding birds in Montana represent a single, large population, with birds in the spring covering large areas in search of suitable breeding habitats. This could explain the pattern of erratic occurrences of small breeding populations, in Canada, in restricted and often temporary areas of suitable habitat.

The 2001 project was the most detailed population and habitat survey conducted to date. Results support previous assessments that the population is very low and erratic and that suitable habitat is very restricted.

In areas where the management priority is Mountain Plover conservation, a program of habitat management is recommended, including the implementation of intensive winter/spring grazing and prescribed burns, and population surveys at key times of the year.

ACKNOWLEDGEMENTS

We are grateful to the following individuals and groups for their assistance in this project: Richard Quinlan and Joel Nicholson, Alberta Sustainable Resource Development; Paul Goossen, Canadian Wildlife Service; David Heydlauff, Wildhorse area landholder; Ian Walker, Manager, Onefour Research Sub-station; and other landholders who helped out with access and range information.

We especially thank Ray Wershler for assistance in the field surveys.

Table of Contents

EXECUTIVE SUMMARY i
ACKNOWLEDGEMENTS iii
1. INTRODUCTION 1
1.1 Background 1
1.2 Objectives 1
2. STUDY AREA 1
3. METHODS 2
3.1 Aerial Survey 2
3.2 Ground Surveys 2
3.2.1 Detailed Surveys 3
3.2.2 Reconnaissance Surveys 3
3.2.3 Assessment of Suitability and Potential 3
3.2.4 Observations of Other Species of Concern 4
3.3 Miscellaneous 4
4. RESULTS 4
4.1 Habitat Potential 4
4.1.1 High Potential Habitats 4
4.1.2 Limited Potential Habitats 5
4.2 Habitat Suitability 6
4.2.1 Habitats with High Suitability 6
4.2.2 Habitats with Limited Suitability 6
4.3 Populations 7
5. DISCUSSION 7
5.1 Drought and Habitat Suitability 7
5.2 Grazing and Habitat Suitability 7
5.3 Habitat Management 8
5.4 Mountain Plover Conservation 8
6. MANAGEMENT IMPLICATIONS AND FUTURE DIRECTIONS 8
6.1 Importance of the Study 8
6.2 Recommendations for Management and Conservation 9
7. LITERATURE CITED 11

LIST OF MAPS

Map 1: Aerial survey route, Mountain Plover habitat, Alberta, May 2001 12

1. INTRODUCTION

1.1 Background

Sweetgrass Consultants Ltd. was contracted by Alberta Fish and Wildlife Division in 2001 to conduct Mountain Plover habitat and population surveys on the Onefour Research Sub-station and adjacent lands. This study complemented similar Mountain Plover surveys being carried out by Sweetgrass Consultants Ltd. in the Grasslands National Park area of Saskatchewan (funded by Parks Canada) and in the remainder of the species' range in southeastern Alberta and southwestern Saskatchewan (funded by Environment Canada). The work funded by Environment Canada also permitted an aerial habitat survey of the Canadian range of the Mountain Plover.

Together, these projects represent the first Mountain Plover survey to sample the diversity of the entire range of the species in Canada. This report summarizes the Alberta portion of the survey work. Individual reports have also been prepared specifically for the overall Canadian range (Wershler and Wallis 2001) and the Grasslands National Park area.

The Mountain Plover is one of 9 bird species endemic to the North America steppe. In Alberta it frequents dry native grasslands recently disturbed by grazing or fire. Typically, nesting requirements include short vegetation, with a significant component of bare ground, on level terrain. The usual clutch is three eggs. Often, two clutches are laid in rapid succession—the first incubated by the male, the second by the female. Mountain Plovers are rare breeders in Alberta, with the main breeding range being in Montana and Colorado. The species has shown the greatest recent declines in North America of any endemic grassland species. (Wershler and Wallis 1986; Wershler 2000).

The Mountain Plover is ranked as a "Sensitive" species in Alberta (Alberta Sustainable Resource Development 2001) and an "Endangered" species in Canada (COSEWIC 2001). As indicated by Wershler (2000), a formal survey of populations and habitats of the Mountain Plover across the Canadian range was needed to provide a clearer picture of the species' status.

1.2 Objectives

The purpose of this study was to survey known and prospective Mountain Plover nesting habitats in southeastern Alberta in order to search for and census breeding birds and to assess habitat potential and suitability. There was an emphasis on the documentation of high potential habitats, and surveying habitats with high suitability in 2001.

2. STUDY AREA

The study area was in the extreme southeastern corner of Alberta, within the Dry Mixedgrass Sub-region of the Grassland Natural Region. It corresponded roughly with

the probable breeding range of the Mountain Plover in the province (Wershler 2000), focusing on previous breeding habitats and potential breeding habitats within extensive areas of native mixed grassland.

3. METHODS

3.1 Aerial Survey

An aerial survey, including the Alberta study area (Map 1), was conducted on May 23, 2001 to identify prospective areas of suitable nesting habitat and sites for ground surveys.

The aerial survey was conducted using a fixed-wing aircraft, flying at an average height of approximately 150 m. The survey route began over documented breeding habitats from previous years and habitats with high suitability that had been identified in preliminary ground surveys in late April 2001. This familiarized the surveyors with the aerial appearance of these sites, which was helpful in the assessment of habitat quality along the remainder of the survey route.

The following features, based on research in Alberta (Wershler and Wallis 1986; Wershler 2000) and in the United States (Knowles and Knowles 1998; U.S. Fish and Wildlife Service 1999), were used as major indicators of possible breeding habitats in the Alberta portion of the aerial survey:

- extensive native upland grassland;
- open, shrub-free areas, or sites with a minor shrub component;
- short vegetation associated with intensive livestock grazing or recent burns;
- relatively level, even topography; and
- better-drained (sandier) soils.

Additional breeding habitat indicators used in the aerial survey included the following:

- the proximity of winter feed areas, watering areas, and concentrations of Richardson's Ground Squirrels (all associated with areas of heavier grazing);
- open solonetzic flats in the Wildhorse area, with similarities to breeding habitats in Montana (Knowles and Knowles 1993); and
- examples of heavily grazed exotic grassland.

Sites identified for ground surveys were briefly described, marked on topographic maps, and identified with UTM grid (NAD27) coordinates using Garmin II+ GPS navigator equipment.

3.2 Ground Surveys

Ground surveys were carried out in sites selected during the aerial survey, additional sites identified during the ground surveys, sites identified in previous years' surveys, and in the vicinity of sightings made by other observers in 2001. On the initial visit to a site, a brief

inspection was carried out in order to (1) ground-truth habitat features noted during the aerial survey, and (2) to determine the general potential of a site and the level of ground survey that was required—detailed or reconnaissance. Sites that were assessed as having low potential were omitted from further survey and analysis.

3.2.1 Detailed Surveys

Detailed surveys were conducted in sites that appeared to have the highest suitability for nesting Mountain Plovers in 2001. Detailed surveys involved walking through habitat in a grid pattern to ensure comprehensive auditory and visual coverage and were carried out at least twice per site—once during the nesting phase (early May-mid June) and once during the fledgling phase (mid June-mid July). Surveys were also conducted during the courtship phase (late April) in previous breeding habitats.

3.2.2 Reconnaissance Surveys

Reconnaissance surveys were conducted in sites considered to have lower suitability for nesting Mountain Plovers in 2001. These included habitats that appeared to be (1) marginally suitable but that could potentially include localized areas of suitable nesting habitat, or (2) currently unsuitable but potentially suitable with appropriate range management. Reconnaissance surveys were usually carried out once per site, mostly during the early part of the breeding season.

Reconnaissance surveys involved slowly driving roads and back roads, stopping at regular intervals to scan habitats with binoculars, or walking through larger, roadless areas and scanning with binoculars.

3.2.3 Assessment of Suitability and Potential

From the detailed and reconnaissance-level ground surveys, a final assessment was made of habitat suitability and potential for each site. Suitability was assessed on the basis of prevailing habitat quality, while potential was assessed based on projected habitat quality given appropriate management practices (e.g. more intensive grazing or controlled burning) in the future.
Assessment of habitat potential and suitability was based primarily on the following parameters of typical breeding habitats (Knowles and Knowles 1998; U.S. Fish and Wildlife Service 1999):

- short vegetation (<10 cm high; <6 cm on av. in Montana);
- relatively level terrain (0-5% slope; generally <2% in Montana);
- a significant bare soil/lichen component (>30% in the U.S.); and
- extensive habitat (min. habitat size for brood-rearing has been estimated at 28 ha; Knopf and Rupert, 1996).

Descriptions of sites assessed with limited to high potential incorporate the following categories of information (sites with low potential have been omitted):

- site location (general and UTM) and description;
- date;
- habitat description (general vegetation/ground cover/vegetation height/grazing intensity/topography);
- habitat suitability and potential assessments;
- previous Mountain Plover records; and
- landholder.

In the event that Mountain Plovers were found during the ground surveys, efforts were to be made to count birds and nests and to describe habitat and grazing history in more detail.

3.2.4 Observations of Other Species of Concern

In addition to Mountain Plover observations, incidental observations of other COSEWIC-listed animal species encountered during the Mountain Plover surveys were recorded. These species included Burrowing Owl, Ferruginous Hawk, Loggerhead Shrike, Long-billed Curlew, Sprague's Pipit and Swift Fox. A record was also included for the first documented report of Eastern Yellow-bellied Racer for Alberta—a specimen was recorded in the Lost River area on May 29. This information will be entered into the provincial Biodiversity Species Observation Database for future management considerations.

3.3 Miscellaneous

Sweetgrass Consultants contributed the following additional components to the project:

- preparation and circulation of a "wanted" poster to inform people within the study area of the survey, illustrate and describe the Mountain Plover and its status, and solicit observations;
- orientation trips to the Malta and Glasgow areas of northern Montana to familiarize the surveyors with Mountain Plover breeding habitats in those areas.

4. RESULTS

4.1 Habitat Potential

A total of 19 sites were assessed as having potential for nesting habitat. These included 17 sites with high potential and 2 with limited potential.

4.1.1 High Potential Habitats

The majority (73%) of Canadian sites assessed with high potential are located in southeastern Alberta—the Lost River-Milk River and Wildhorse regions and adjoining

lands in the southwestern corner of Saskatchewan, within 16 km of the Alberta-Saskatchewan boundary.

Lost River-Milk River

The most extensive high potential habitat in Canada is upland grassland in the Lost River-Milk River region. This area encompasses periodically suitable nesting habitat on the Onefour Research Sub-station and relatively large areas of high potential habitat on the Lost River Ranch and the Onefour Research Sub-station that have been mostly unsuitable due to inadequate levels of grazing. Topography is mostly level and smooth-surfaced; soils are non-saline, sandy loam, formed over outwash materials; and drainage is fairly good to good (Wallis 1976).

Wildhorse

High potential habitat in the Wildhorse region, near the Alberta-Saskatchewan boundary, is of two basic types: (1) concentrations of discontinuous, level grassland sites within grassland-sagebrush and lower-lying, solonetzic areas; and (2) grassland similar in character to that in the Lost River-Milk River area, but less uniform and continuous because of occasional areas with more undulating to rolling topography, and localized areas of solonetzic blow-outs and scattered sagebrush. The most recent breeding records of Mountain Plover in Canada were recorded in habitat of the first type.

High potential habitat in the Wildhorse region, of the second type, continues into the Govenlock area of Saskatchewan and, from a national perspective, is referred to as the Wildhorse-Govenlock region (Wershler and Wallis 2001).

4.1.2 Limited Potential Habitats

Lost River-Milk River

Although no sites of limited potential in this region were surveyed, there are areas of limited potential to the north, east and southeast of Onefour. These include localized areas of relatively level to undulating, better-drained grassland within a generally solonetzic, blowout-sagebrush habitat. Some of these sites could prove to be of high potential; however, their true potential is difficult to assess at this time because these areas have been generally lightly to moderately grazed over the last three decades.

Wildhorse

Habitats with limited potential in this region include grassland with a larger component of undulating topography, blowouts and sagebrush.

4.2 Habitat Suitability

A total of 8 of the 17 high potential sites were assessed as having high suitability in 2001, while 9 were of limited suitability.

4.2.1 Habitats with High Suitability

Lost River-Milk River

In this region, habitat with high suitability in recent decades has been mostly restricted to relatively small areas on the Onefour Research Sub-station.

In the 2001 survey, there appeared to be a greater area of more heavily grazed grassland than observed in recent decades. However, this was at least partly related to ongoing severe drought conditions in the region. Two very dry growing seasons (2000-2001), combined with four winters with little or no snow cover, resulted in significant declines in plant vigor and litter (Barry Adams, Range Management Specialist, Alberta Sustainable Resource Development, Lethbridge, unpublished data). Some portions of southeastern Alberta showed little or no green growth throughout the survey period.

Because of the effects of the drought, grassland that had received light to moderate grazing often had the appearance of more heavily grazed range. In addition, because of the general scarcity of adequate forage resources, some areas may have been grazed for a longer duration or at higher rates than in previous years. By mid July, most grazed areas looked even more barren than in spring.

In future years, there may be additional suitable habitat created on the Onefour Research Sub-station relating to a multi-year study, begun in 2001, to compare the effects of various grazing rates. At this early stage, it is uncertain whether levels of heavier grazing will be appropriate for the creation and maintenance of significant areas of suitable Mountain Plover habitat.

Wildhorse

As part of the area affected by continuing drought, this region also appeared to be more heavily grazed than in years past, and the vegetation was shorter and sparser than usual. Drought conditions in this region in 2001 were rated from severe to extreme. The driest part of the region included sites with the most recent nesting records (in 1990 and 1994).

4.2.2 Habitats with Limited Suitability

In addition to habitat suitability being limited by low habitat potential, a major factor limiting the suitability of high potential Mountain Plover habitats in both regions was the lack of larger areas of intensively grazed habitat (Section 5.2).

4.3 Populations

No Mountain Plovers were found in the formal surveys in Alberta, or in Saskatchewan (Wershler and Wallis 2001). However, three observations were reported in the 2001 breeding season by local residents in the Alberta portion of the study area: 1 adult south of Onefour in late April (Ian Walker, Onefour Sub-station manager); 1 adult northeast of Wildhorse in May (David Heydlauf, lessee); and 2 adults northeast of Wildhorse in May (David Heydlauf, lessee). Both observers were familiar with Mountain Plovers, and all observations were in the general areas of previous documented nesting records.

The three sites with 2001 observations were searched during the ground surveys but no Mountain Plovers were recorded. In only one case, the observation of two birds, did the habitat appear unsuitable for Mountain Plovers—this site was lightly grazed.

5. DISCUSSION

5.1 Drought and Habitat Suitability

Two studies suggest that drought conditions can have negative effects on Mountain Plover reproductive success. In Wyoming, early departure from the breeding grounds in late June was attributed to extreme drought conditions (Leachman and Osmundson 1990). In Colorado, low fledgling rates have been hypothesized to occur during drought years when low food supply leads to increases in predator pressures (Knopf and Rupert 1996).

While a number of drought-stricken habitats in Alberta were considered to be of high suitability in the 2001 survey, they may have actually been less suitable than they appeared. The majority of Mountain Plover nesting records in Alberta have been in non-drought years.

5.2 Grazing and Habitat Suitability

A major factor limiting the quality of Mountain Plover habitat in Alberta, and across its Canadian range, is the scarcity of larger areas of short, sparse grassland vegetation. Current range management emphasizes conservative stocking rates and moderately grazed grassland. While this promotes a range of habitats, and benefits a diversity of wildlife species, the relatively small patches of more heavily grazed grassland are generally too restricted for the establishment and maintenance of suitable breeding habitat for Mountain Plovers.

If habitat is to be managed for Mountain Plovers, more intensive grazing is required, especially in winter or early spring. Winter and spring grazing have been identified as very important for habitat creation in upland grassland in Montana (Knowles and Knowles 1998), while in Alberta, most nests have been found in winter-grazed pastures (Wershler and Wallis 1986). Removal of the previous season's plant litter by the beginning of the breeding season is a prerequisite for suitable Mountain Plover breeding habitat. The following exceptions to these requirements have been documented for

Montana: (1) moderately grazed alluvial flats with naturally sparse, low vegetation, and (2) moderately grazed areas with prairie dog activity where extensive short vegetation and bare ground can be maintained (Knowles and Knowles 1998).

5.3 Habitat Management

The management of grassland habitat for breeding Mountain Plovers can be undertaken in the following ways: (1) implementing or encouraging intensive grazing of livestock, especially during the winter and spring; (2) prescribed burning programs; and (3) encouraging the growth and maintenance of black-tailed prairie dog colonies (Knowles and Knowles 1998).

5.4 Mountain Plover Conservation

Regarding the conservation of Mountain Plovers in Montana, Knowles and Knowles (1998) state that it is possible to manage for the species, but this probably only has significance where breeding populations already exist. Some sites with apparently suitable habitat are considered too distant from other populations to be used. The persistence of Mountain Plover populations apparently requires multiple suitable sites widely spaced over a minimum area of approximately 25 km^2.

Knowles and Knowles (1998), however, also state that there are some cases where apparently small breeding populations persist in areas isolated from other populations. This may relate to the species' high mobility and dispersal potential. It is possible that Mountain Plovers in Montana represent a single breeding population and that birds arriving in the spring cover large areas searching for suitable breeding habitat. Conservation of small breeding populations is considered very important for maintaining Mountain Plovers in the state over the long term.

In Canada, following agricultural settlement, small numbers of Mountain Plovers have been recorded on a sporadic basis; however, occurrence appears to be mainly traditional. Nesting has been recorded for a period of several years in both the Wildhorse and Lost River areas, in the general locations of historic records and collections. In some years, including 2001, adults have been recorded early in the spring but not seen for the remainder of the breeding season.

6. MANAGEMENT IMPLICATIONS AND FUTURE DIRECTIONS

6.1 Importance of the Study

The 2001 survey provides an update on the status of Mountain Plover in Alberta and represents the most detailed population and habitat survey conducted to date. Results support previous assessments that the population is very low and erratic and that the suitability of the majority of key, high potential habitat is not receiving the type of management required for the creation of productive Mountain Plover breeding habitat.

Complementary studies in the Saskatchewan portion of the species' range have confirmed the relative significance of habitats in Alberta and identified areas of high potential in the Govenlock area of Saskatchewan, contiguous with high potential areas in the Wildhorse area of Alberta.

In order to more adequately assess the potential of breeding habitats in Alberta, a program of habitat management is recommended in key areas of high potential habitat, combined with searches for birds at key times of the year.

6.2 Recommendations for Management and Conservation

If the management priority in certain areas is determined to be for Mountain Plover conservation, the following recommendations should be followed:

1. Encouragement of intensive winter/early spring grazing in high potential habitats in the general vicinity of traditional breeding areas to improve habitat suitability and possibly attract birds arriving in the early spring. This should include prescribed burn trials for habitat enhancement. The current study on the Onefour Research Sub-station into the effects of various levels of grazing incorporates a research component on breeding birds. While the current scope of this program may not meet the recommended requirements for Mountain Plover habitat enhancement, it is an important initial step and, with an expanded mandate, could serve as an important vehicle in Mountain Plover research and conservation in the future.

2. Continuing surveys for breeding birds in habitats with high suitability, with an emphasis on traditional breeding areas. This should include early surveys in mid April-early May when birds return from the wintering grounds. Few surveys have been conducted at this time of year.

3. Surveys for breeding birds in habitats of limited or unknown potential, including examples that resemble productive atypical nesting habitats in northern Montana; for example, solonetzic flats and localized areas with limited potential in southeastern Alberta that have not been adequately surveyed.

4. Any birds found in future years should be carefully observed for color-band combinations. Birds have been color-banded in recent years in a research project in north-central Montana (John Grensten, Bureau of Land Management, Malta, pers. comm.). The relationship between nesting populations in Canada and Montana is unknown.

5. If nesting birds are discovered, then:
(1) conduct surveys to document population size, habitat use and nesting success. This is especially important in the Wildhorse area where there has been limited study and documentation of breeding birds.

(2) apply habitat enhancement efforts (intensive grazing and prescribed burning) directed toward improving and expanding suitable habitat in the nesting areas and adjacent high potential habitats.

6. Significant efforts in population surveys and habitat management programs should coincide with more favorable climatic conditions (non-drought periods). An improvement in moisture conditions in 2002 following the current drought could potentially create ideal breeding habitat—even if moisture conditions were to improve, there would be a delay in the recovery of forage and litter resources.

7. LITERATURE CITED

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2001. 2001 species at risk in Canada. Ottawa.

Knopf, F.L. and J.R. Rupert. 1996. Reproduction and movements of mountain plovers breeding in Colorado. Wilson Bulletin 108:28-35.

Knowles, C.J. and P.R. Knowles. 1993. Mountain Plover numbers, reproduction, and habitat use in three areas of Montana. Unpublished report prepared by FaunaWest Wildlife Consultants, Boulder, for Bureau of Land Management Montana State Office, Billings. 34pp + appendices.

Knowles, C.J. and P.R. Knowles. 1998. The historic and current status of the Mountain Plover in Montana. Unpublished report prepared by FaunaWest Wildlife Consultants, Boulder, for Bureau of Land Management Montana State Office, Billings. 43pp + appendices.

Leachman, B. and B. Osmundson. 1990. Status of the Mountain Plover: a literature review. U.S. Fish and Wildlife Service, Golden, Colorado. 83pp.

Soper, J.D. 1939. The Mountain Plover in western Canada. Canadian Field-Naturalist 55:137.

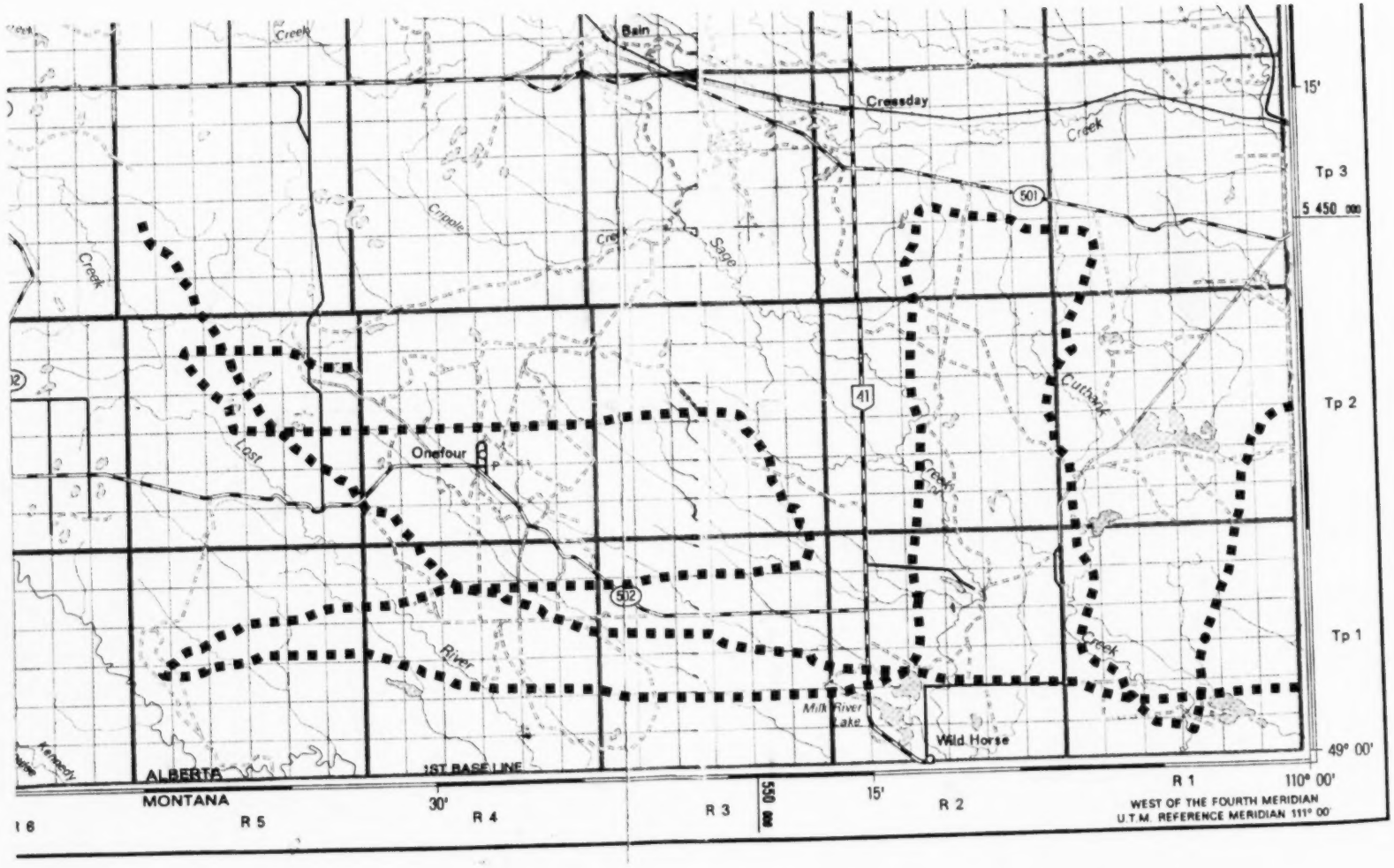
U.S. Fish and Wildlife Service. 1999. Endangered and threatened wildlife and plants: proposed threatened status for the Mountain Plover. Federal Register 64(30):7587-7600.

Wallis, C. 1976. Milk River Canyon resource evaluation, 1976. Unpublished report, Alberta Recreation, Parks and Wildlife, Edmonton. 122pp.

Wershler, C.R. 2000. Update COSEWIC status report on Mountain Plover (*Charadrius montanus*) in Canada. Committee on the Status of Endangered Wildlife in Canada. 31pp.

Wershler, C.R. and C.A. Wallis. 1986. Status of the Mountain Plover, *Charadrius montanus*, in Canada. Committee on the Status of Endangered Wildlife in Canada. 40pp.

Wershler, C.R. and C.A. Wallis. 2001. Mountain Plover habitat and population surveys—Alberta and Saskatchewan, 2001. Prepared by Sweetgrass Consultants Ltd. for Environment Canada, Prairie & Northern Region, Edmonton. 44pp.



MAP 1. AERIAL SURVEY ROUTE, MOUNTAIN PLOVER HABITAT, ALBERTA, MAY 2001

List of Titles in This Series

(as of March 2002)

No. 1 Alberta species at risk program and projects 2000-2001, by Alberta Sustainable Resource Development, Fish and Wildlife Division. (2001)

No. 2 Survey of the peregrine falcon (*Falco peregrinus anatum*) in Alberta, by R. Corrigan. (2001)

No. 3 Distribution and relative abundance of the shortjaw cisco (*Coregonus zenithicus*) in Alberta, by M. Steinhilber and L. Rhude. (2001)

No. 4 Survey of the bats of central and northwestern Alberta, by M.J. Vonhof and D. Hobson. (2001)

No. 5 2000 survey of the Trumpeter Swan (*Cygnus buccinator*) in Alberta, by M.L. James and A. James. (2001)

No. 6 2000/2001 Brassy Minnow inventory at Musreau Lake and outlet, by T. Ripley. (2001)

No. 7 Colonial nesting waterbird survey in the Northwest Boreal Region – 2000, by M. Hanneman and M. Heckbert. (2001)

No. 8 Burrowing owl trend block survey and monitoring - Brooks and Hanna areas, by D. Scobie and R. Russell. (2000)

No. 9 Survey of the Lake Sturgeon (*Acipenser fulvescens*) fishery on the South Saskatchewan River, Alberta (June-September, 2000), by L.A. Winkel. (2000)

No. 10 An evaluation of grizzly bear-human conflict in the Northwest Boreal Region of Alberta (1991-2000) and potential mitigation, by T. Augustyn. (2001)

No. 11 Harlequin duck monitoring in the Northern East Slopes of Alberta: 1998-2000 preliminary results, by J. Kneteman and A. Hubbs. (2000)

No. 12 Distribution of selected small mammals in Alberta, by L. Engley and M. Norton. (2001)

No. 13 Northern leopard frog reintroduction. Raven River - Year 2 (2000), by K. Kendell. (2001)

No. 14 Cumulative effects of watershed disturbances on fish communities in the Kakwa and Simonette watersheds. The Northern Watershed Project. Study 3 Progress report, by T. Thera and A. Wildeman. (2001)

No. 15 Harlequin duck research in Kananaskis Country in 2000, by C.M. Smith. (2001)

No. 16 Proposed monitoring plan for harlequin ducks in the Bow Region of Alberta, by C.M. Smith. (2001)

No. 17 Distribution and relative abundance of small mammals of the western plains of Alberta as determined from great horned owl pellets, by D. Schowalter. (2001)

No. 18 Western blue flag (*Iris missouriensis*) in Alberta: a census of naturally occurring populations for 2000, by R. Ernst. (2000)

No. 19 Assessing chick survival of sage grouse in Canada, by C.L. Aldridge. (2000)

No. 20 Harlequin duck surveys of the Oldman River Basin in 2000, by D. Paton. (2000)

No. 21 Proposed protocols for inventories of rare plants of the Grassland Natural Region, by C. Wallis. (2001)

No. 22 Utilization of airphoto interpretation to locate prairie rattlesnake (*Crotalus viridis viridis*) hibernacula in the South Saskatchewan River valley, by J. Nicholson and S. Rose. (2001)

No. 23 2000/2001 Progress report on caribou research in west central Alberta, by T. Szkorupa. (2001)

No. 24 Census of swift fox (*Vulpes velox*) in Canada and Northern Montana: 2000-2001, by A. Moehrenschlager and C. Moehrenschlager. (2001)

No. 25 Population estimate and habitat associations of the long-billed curlew in Alberta, by E.J. Saunders. (2001)

No. 26 Aerial reconnaissance for piping plover habitat in east-central Alberta, May 2001, by D.R.C. Prescott. (2001)

No. 27 The 2001 international piping plover census in Alberta, by D.R.C. Prescott. (2001)

No. 28 Prairie rattlesnake (*Crotalus viridis viridis*) monitoring in Alberta – preliminary investigations (2000), by S.L. Rose (2001)

No. 29 A survey of short-horned lizard (*Phrynosoma hernandesi hernandesi*) populations in Alberta, by J. James (2001)

No. 30 Red-sided garter snake (*Thamnophis sirtalis parietalis*) education and relocation project – final report, by L. Takats (2002)

No. 31 Alberta furbearer harvest data analysis, by K.G. Poole and G. Mowat (2001)

No. 32 Measuring wolverine distribution and abundance in Alberta, by G. Mowat (2001)

No. 33 Woodland caribou (*Rangifer tarandus caribou*) habitat classification in northeastern Alberta using remote sensing, by G.A. Sanchez-Azofeifa and R. Bechtel (2001)

No. 34 Peregrine falcon surveys and monitoring in the Parkland Region of Alberta, 2001, by R. Corrigan (2002)

No. 35 Protocol for monitoring long-toed salamander (*Ambystoma macrodactylum*) populations in Alberta, by T. Pretzlaw, M. Huynh, L. Takats and L. Wilkinson (2002)

No. 36 Long-toed salamander (*Ambystoma macrodactylum*) monitoring study in Alberta: summary report 1998-2001, by M. Huynh, L. Takats and L. Wilkinson (2002)

No. 37 Mountain plover habitat and population surveys in Alberta, 2001, by C. Wershler and C. Wallis (2002)

No. 38 A census and recommendations for management for western blue flag (*Iris missouriensis*) in Alberta, by R. Ernst (2002)

No. 39 Columbian mountain amphibian surveys, 2001, by D. Paton (2002)

No. 40 Management and recovery strategies for the Lethbridge population of the prairie rattlesnake, by R. Ernst (2002)

No. 41 Western (*Aechmophorus occidentalis*) and eared (*Podiceps nigricollis*) grebes of central Alberta: inventory, survey techniques and management concerns, by S. Hanus, H. Wollis and L. Wilkinson (2002)

No. 42 Northern leopard frog reintroduction – year 3 (2001), by K. Kendell (2002)

No. 43 Survey protocol for the northern leopard frog, by K. Kendell (2002)

No. 44 Alberta inventory for the northern leopard frog (2000-2001), by K. Kendell (2002)

No. 45 Fish species at risk in the Milk and St. Mary drainages, by RL&L Environmental Services Ltd. (2002)

No. 46 Survey of the loggerhead shrike in the southern aspen parkland region, 2000-2001, by H. Kiliaan and D.R.C. Prescott (2002)

No. 47 Survey of native grassland butterflies in the Peace parkland region of northwestern Alberta – 2001, by M. Hervieux (2002)

No. 48 Caribou range recovery in Alberta: 2001/02 pilot year, by T. Szkorupa (2002)

No. 49 Peace parkland native grassland stewardship program 2001/02, by A. Baker (2002)

No. 50 Carnivores and corridors in the Crowsnest Pass, by C. Chetkiewicz (2002)